

# Potential Health Benefits of Functional Foods in Boosting Immunity and Relationship between Immunosuppressant Diseases and Severity of Viral Infections-COVID-19 – A Review Article

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## ABSTRACT

COVID-19 pandemic has been a global challenge to all the nations and has really affected the sense of normalcy in the lives of People. It has been a sense of awakening that has made people realize the role of immunotherapy in fighting against such situations. It has been observed that the strong gut-associated lymphoid tissue (GALT) which accounts as a dominant role in the immunity has a very important role to play in strengthening the immune system. Dysbiosis could be a major cause of many health disorders and immune suppressants diseases. It was strongly observed that patients with compromised immune system badly affected in COVID-19. In this review, we are trying to find out the association between functional foods such as Probiotics, Prebiotics, and various other Nutraceuticals in strengthening the immune system and its potential benefit to act as preventive medicine in curbing down incidence or management of COVID-19.

**Keywords:** Functional foods, Gut-associated lymphoid tissue, Immunotherapy, Nutraceuticals, Prebiotics, Probiotics

*Asian Pac. J. Health Sci.*, (2022); DOI: 10.21276/apjhs.2022.9.45.48

## INTRODUCTION

At present, people across the globe are sparring against the coronavirus disease 2019 (COVID-19) pandemic, wherein the immunity of an individual is a concerning factor. The WHO COVID-19 Dashboard, 2021 confirmed around 2,804,120 fatalities and on April 01, 2021, there have been over 128,223,872 confirmed cases of COVID-19. Although all governments are doing an excellent job in developing as well as deploying the vaccines, around the world; however considering various challenges in our system, the concept of herd immunity is a long way to be achieved.

McDermott *et al.*, in 2020,<sup>(1)</sup> stated that in spite of being the respiratory disease, there are evidences that support the impact of COVID-19 on the gastrointestinal system and manifestations. The gut-associated lymphoid tissue (GALT) is the largest mass of lymphoid tissue in the body. It consists of various types of immune cells such as B and T lymphocytes, antigen-presenting cells, and macrophages, including dendritic cells, and specific epithelial and intra-epithelial lymphocytes. GALT is a component of mucosa-associated lymphoid tissue, which works in the immune system to protect any type of invasion in the gut.

GALT makes up about 70% of the immune system by weight. The impact of COVID on gastrointestinal tract can lead to dysbiosis and even can hamper the immunity and fighting capacity of an individual. At present, there are no specific antiviral drugs or vaccines available for therapeutic purposes to fight against COVID-19.

Immune system our own defense or fighting system helps our body to fight against this aggressively progressing and mutating virus. Immunoboosting therapy has now been in the spotlight. In addition to that, gut health has also gained importance in improving one's immunity. Intake of functional foods on daily basis can help to boost the immune system and would be a step toward boosting the immune system to combat this global pandemic. However, some studies have linked that the intake of certain functional foods such as – probiotics, prebiotics,

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**How to cite this article:** Kuthiala R, Jindal P, Nalwaya NC. Potential Health Benefits of Functional Foods in Boosting Immunity and Relationship between Immunosuppressant Diseases and Severity of Viral Infections-COVID-19 – A Review Article. *Asian Pac. J. Health Sci.*, 2022;9(45):252-255.

**Source of support:** Nil

**Conflicts of interest:** None.

**Received:** 11/04/2022 **Revised:** 16/05/2022 **Accepted:** 08/06/2022

flavonoids, pigments, and phytosterols could possibly improve the host immunity and helps in fighting against the invasive virus. Our Functional Food and Beverage and Supplements 2020 report finds that almost a third of consumers say that they are consuming more supplements (31%) and functional foods or functional beverages (29%). This can take the form of adopting entirely new solutions shift in the eating behaviors of the consumers.

The International Year of Fruits and Vegetables 2021 (IYFV), as declared by the UN General Assembly aims at enhancing the awareness of functional foods and thereby the significance of immunity. This has catalyzed the understanding of the importance of nutrients and overall nutrition in our daily routine. Not only fruits and vegetables but also herbs and spices when used accordingly can help in boosting the immunity. A good immunity could only be the remedy to develop the strength to fight against this deadly virus. It has been observed in so many studies and even on media

that people suffering from immunosuppressant diseases such as – diabetes, hypertension, obesity, and cardiovascular diseases have been affected the most in such period. Functional Foods and Nutraceuticals would work directly on immunotherapy which helps to fight against this deadly virus.

### Why Functional Foods?

IYFV, as declared by the UN General Assembly, aims at enhancing the awareness of functional foods and thereby the significance of immunity.

According to Calder *et al.*, 2020<sup>[2]</sup> in his study on “Optimal Nutritional status for a well-functioning immune system against viral infections,” a compromised immune system has deficient micronutrients stores particularly in vitamins – A, B<sub>6</sub>, B<sub>12</sub>, C, D, E, Folate and trace elements including Zinc, Iron, selenium (Kiremidjian-Schumacher and Roy, 1998 and Newman *et al.*, 2019),<sup>[11,12]</sup> magnesium, and copper.

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It has been observed in so many studies and even on media that people suffering from immunosuppressant diseases like – diabetes, hypertension, obesity, and cardiovascular diseases have been affected the most in such period. In one of the study conducted by Fang *et al.*, 2020<sup>[3]</sup> on COVID-19, it was well documented that older adults and patients with obesity, cardiac diseases, hypertension, or diabetes are most vulnerable with higher infection and mortality rates. Older people and people with medical problems such as asthma, diabetes, and heart disease are most susceptible for becoming severely ill.

Diabetes is now considered as risk factor for the progression and prognosis of COVID-19 (Hussain *et al.*, 2020 and Guo *et al.*, 2020).<sup>[4,5]</sup>

### IMPACT OF FUNCTIONAL FOODS ON COVID-19

Functional Foods also called as Super foods have always occupied a dominant space in the balanced diet. Indian diet knowingly or unknowingly has been the source of many antibacterial and antiviral bioactive compounds rich foods which, over the years, have proven their medicinal properties. The focus has now been shifted from the artificially made or processed foods to functional foods and herbal medicines which include all fruits, vegetables, fish oils, polyphenol rich herbs, probiotics, prebiotics, and fermented products, as they help build the immune system. They have also shown effectiveness on metabolic and microvascular activities, cholesterol, lowering of blood glucose levels, anti-inflammation, and anti-oxidation even in high-risk populations. Such benefits of these functional foods can be translated into protection against viral infections such as COVID-19.

Strengthening the antiviral immune defense can be benefited from the functional food intake as they contain naturally occurring vitamins and minerals (including Vitamins C, D, B<sub>6</sub>, B<sub>12</sub>, A, E, zinc, copper, selenium, and iron), as well as other phenolic compounds which are immunoprotective, especially due to their anti-oxidative and anti-inflammatory properties. Foods such as oily fish consist of monounsaturated fatty acids such as Omega-3 fatty acids (EPA and DHA) that support inflammatory resolution and healing of infected sites which may include the respiratory tract, preventing

acute lung injury or failure (Rogerero *et al.*, 2020).<sup>[16]</sup>

Probiotics are cultures (single or mixed) of live microorganisms beneficially affecting the maintenance of intestinal and lung microbiota in the host's body. At present, there exists good scientific evidence supporting the ability of probiotics in boosting human immunity, thereby preventing colonization of pathogens and reducing the severity of infections.

The lifestyle and approaches toward health has a very strong and cumulative effect on immune system, which is very essential as antiviral long-term preventative role. Functional foods and bioactive compounds – Nutraceuticals are the future curative and preventive procedures which are real cost effective strategies to enhance the immune system against pathogenic viral infections.

Functional foods are associated with disease prevention and are widely accepted for the prevention and management of major NCDs such as diabetes and cardiovascular-immunosuppressant and oxidative stress disorders affected the worst in the COVID-19 (Alkhatib *et al.*, 2012 and Johnston, 2009).<sup>[6,7]</sup>

### How would Functional Foods Work?

Functional foods are the dietary items that would not only provide nutrients and energy but they would also provide their benefits in the diet during effective treatment in the diseases by enhancing the physiological response and/or reducing the risk of disease (Martirosyan and Singh, 2015).<sup>[14]</sup>

Hence, these components may not directly participate in inhibition response against coronavirus, but holistic approach toward immunity plays an important role in preventive defense against COVID-19.<sup>[15]</sup> Hence, the functional foods components such as probiotics and micronutrient supplements, help to maintain the healthy gut-second brain by maintaining the microflora and bacterial colonies and can strengthen the immune system.

### GUT LUNG AXIS AND COVID-19

There is quite a assembling evidence that bidirectional communications exist between gut and lung called as gut-lung axis involved in immune homeostasis.

Hufnagl *et al.*, 2020<sup>[23]</sup> in his study on “Dysbiosis of the gut and lung microbiome” that gut inflammation can lead to lung inflammation through this connection. This also works other way COVID-19 may induce lung microbiota disruption that modulates the GI tract microbiota, resulting in GI tract Symptoms.

Strains such as *Lactobacillus paracasei*, *Lactobacillus gasseri*, *Lactobacillus acidophilus*, and *Lactobacillus bulgaricus* can secrete number of pro inflammatory cytokine, IL-12 which stimulates natural killer cells–macrophages, the first cells in contact with bacteria and viruses (Kitazawa *et al.*, 1994).<sup>[24]</sup> In meta-analysis of 52 published, research studies which investigated the ability of probiotics to prevent or treat several disorder conditions, the strongest support was in five diseases including – acute respiratory tract infections. In another meta-analysis, King *et al.* evaluated 17 randomized controlled trials that assess the preventive effects of probiotics against acute lower digestive tract infections and acute respiratory tract infections. Fermented food products (e.g., yoghurt, pickles, fermented fruits, vegetables, and drinks) contain probiotic strains that have shown to enhance gut bacteria profile by terminating the dysbiosis and improving gut–lung axis-related respiratory fitness.

**Table 1:** List of functional food ingredients and their effect on boosting immune health

Name of Functional food	Mechanism of Immune Boosting
Micronutrients (Selenium)	Effect immunostimulant Activities <sup>[11]</sup>
Probiotics	Modulate the Immune system
Vitamin A, C, E	Prevent damage to the immune cells <sup>[13]</sup>
Vitamin D supplements	Reducing the risk of respiratory tract infections
Omega-3 fatty acids supplements (EPA and DHA)	Reduce COVID-19 severity and shorten recovery period of patients infected with SARS-CoV-2 <sup>[16]</sup>
Flavonoids	Modulate the immune system (antioxidant and anti-inflammation properties) <sup>[17][18]</sup>
Carotenoids and herbs	Regulate and stimulate Immune response <sup>[19][20]</sup>
Curcumin	Anti-Inflammatory role <sup>[21]</sup>
Olive based products	Reduce upper respiratory tract infection attributed to antioxidant properties of Oleuropein
B2, B6, B12, Folic acid, beta carotene, iron, and plant cyclotides	Promote anti-oxidant and anti-inflammation properties to protect the respiratory system and preventing malfunctioning of the pathogens <sup>[22]</sup>

## SIGNIFICANCE OF GUT HEALTH

In general, the biodiversity of GI microbes decreases with age and excessive antibiotics therapy. This has been remarkably linked with several infectious, metabolic or inflammatory diseases and conditions such as malnutrition, colon cancer, obesity, diabetes, and atherosclerosis. Elderly patients with disordered microbiota are most susceptible to COVID-19. Hence, probiotic supplementation in these age groups could likely enhance the ability of the GI microbiota to stimulate immune defense activity and thus prevent viral infections like COVID-19.

Although vaccinations are being done successfully, their efficacy could be limited due to mutations in virus as observed can increase the risk of infections and threat to public health due to recurrent widespread outbreaks (Barcik *et al.*, 2020).<sup>[8]</sup>

The gut microbiota has the ability to interact with immune cells making favorable changes to host immune system (Zhang *et al.*, 2015).<sup>[10]</sup>

The microbial communities in the human GI tract, skin, lungs, and mouth exist in the commensal relationship with the host cells.<sup>[9]</sup>

The Table 1 depicts the list of functional foods ingredients and their effect on boosting Immune Health.

Vitamin A,C,D,E they help in prevention of damage of cells and also reduces respiratory infections. Curcumin which is the main constituent of turmeric has an anti-inflammatory role.<sup>[21]</sup> There are various functional foods listed with their mechanism explained below in Table 1.

## CONCLUSION

COVID-19 is a sense of awakening in people in context of immunotherapy in people's mind. Virus would keep on mutating and even the effect of vaccination would not be effective in

weakened immune system. This outbreak not only has spread worldwide but also put forward a serious and important thought "Health and immunity has ruled the whole scenario," vaccination and other measures may take their own time but your immunity and nutrition would help to survive this national crisis. Increased intake of probiotics also help in fight against viral infections by maintaining human gastrointestinal tract. However, there is no specific dietary guidelines to enhance immune system, but good lifestyle and the intake of functional foods the super foods would help in saving from such deadly times. There is nothing better than food to be used as preventive medicine against this national crisis.

Functional foods and their role not only help in strengthening the gut health but also helps in fighting against this deadly virus SARS-CoV-2 and any viral illnesses.

Many studies concluded that dysbiosis can make a person vulnerable to viral illnesses and diarrhea in infections like COVID-19, which, further, leads to depletion of micronutrients such as Zinc, Magnesium, Manganese, water soluble vitamins – delaying process of recovery or severity and further worsening the combination of good versus bad microbiota.

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